

Wavelength Shifter (With Stabilization and Data Encoding)

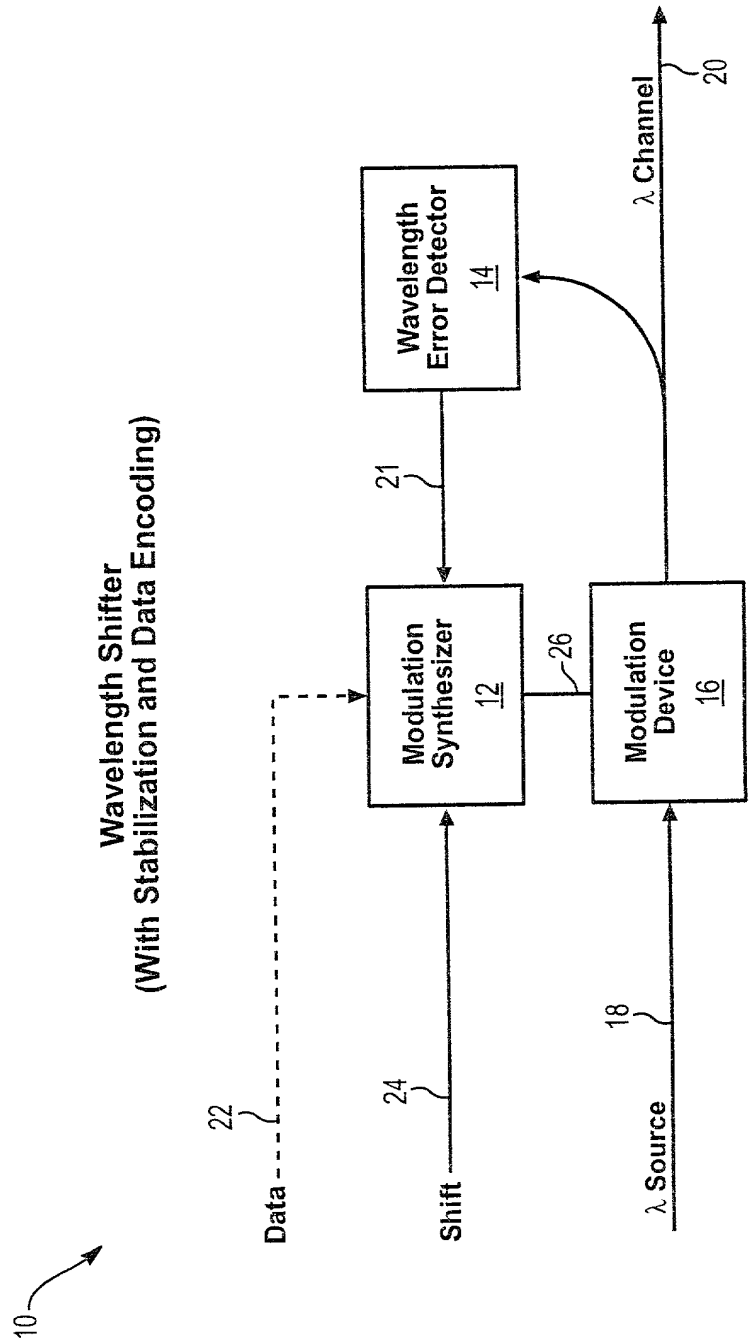


FIG. 1

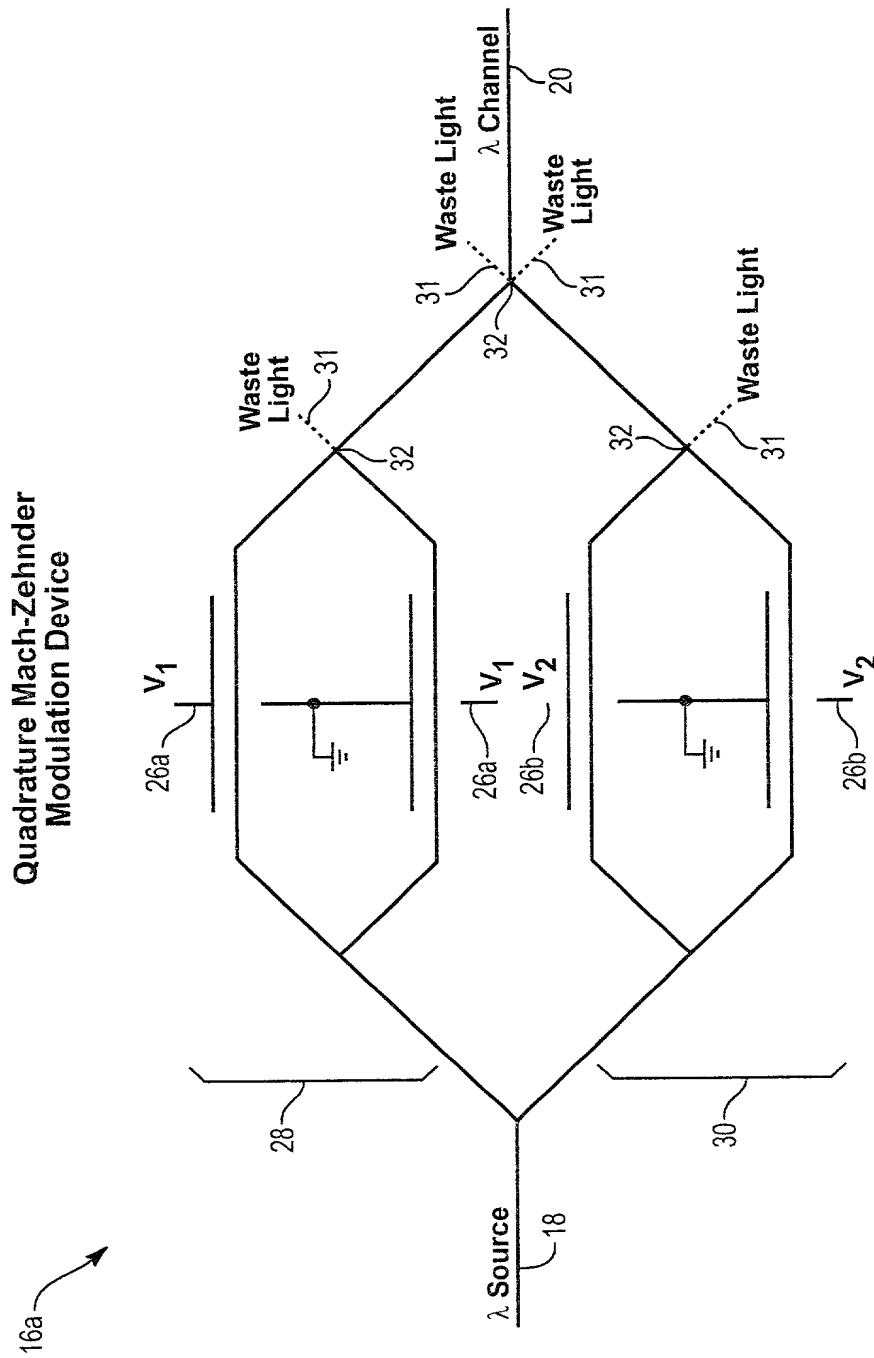


FIG. 2

When any one of the two input signals is zero, the output is zero. The output is zero when both input signals are zero.

### Mach-Zehnder Device Transfer Function

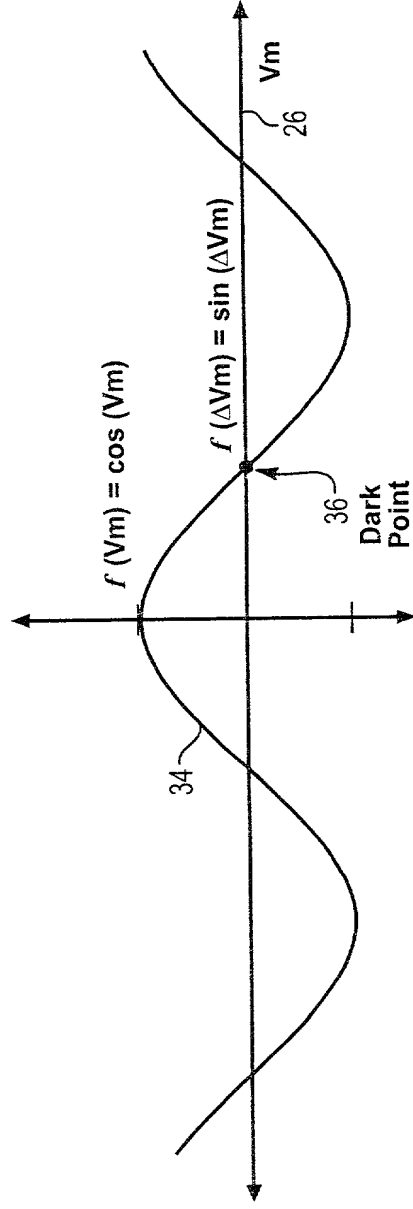


FIG. 3

12

# Modulation Synthesizer

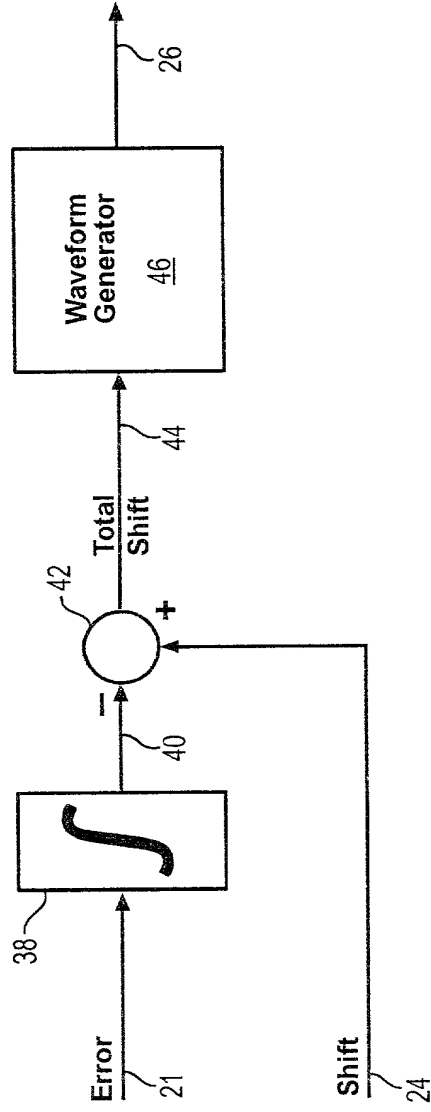


FIG. 4

12

# Quadrature Modulation Synthesizer (With On/Off Data Keying)

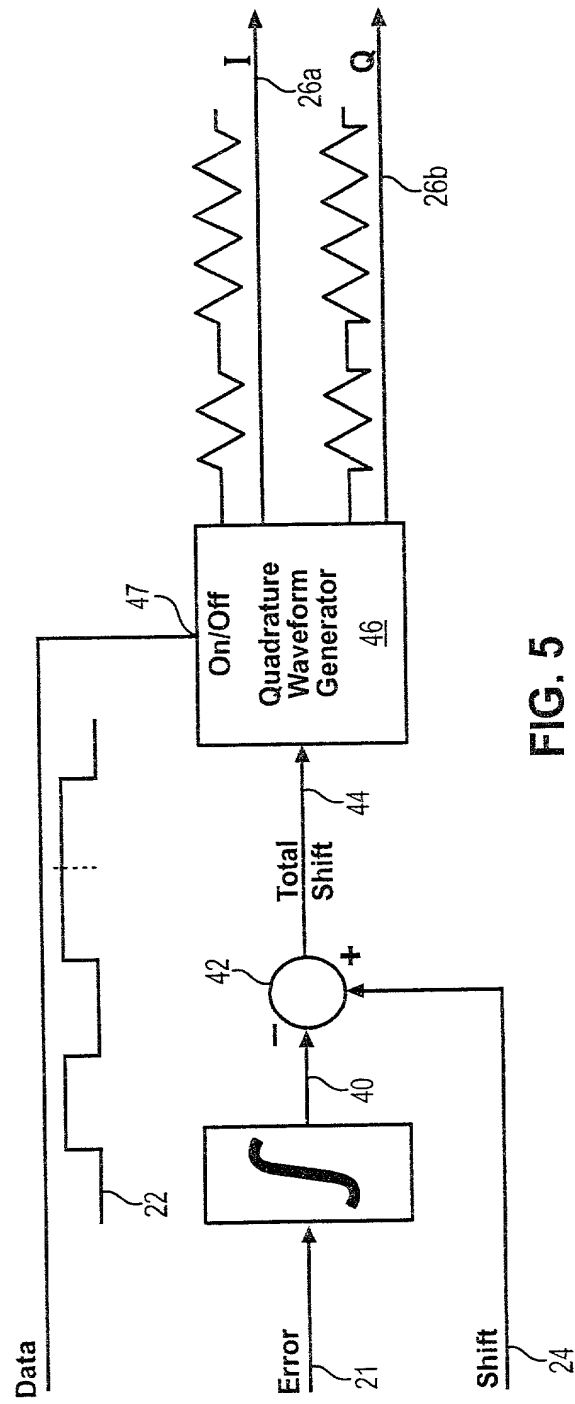


FIG. 5

FIG. 6 is a schematic diagram of a phase modulation device.

### Phase Modulation Device

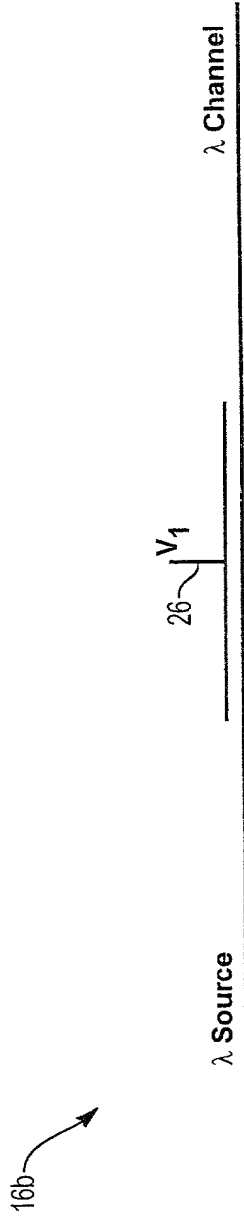


FIG. 6

# Modulation Synthesizer (With Frequency Shift Keying)

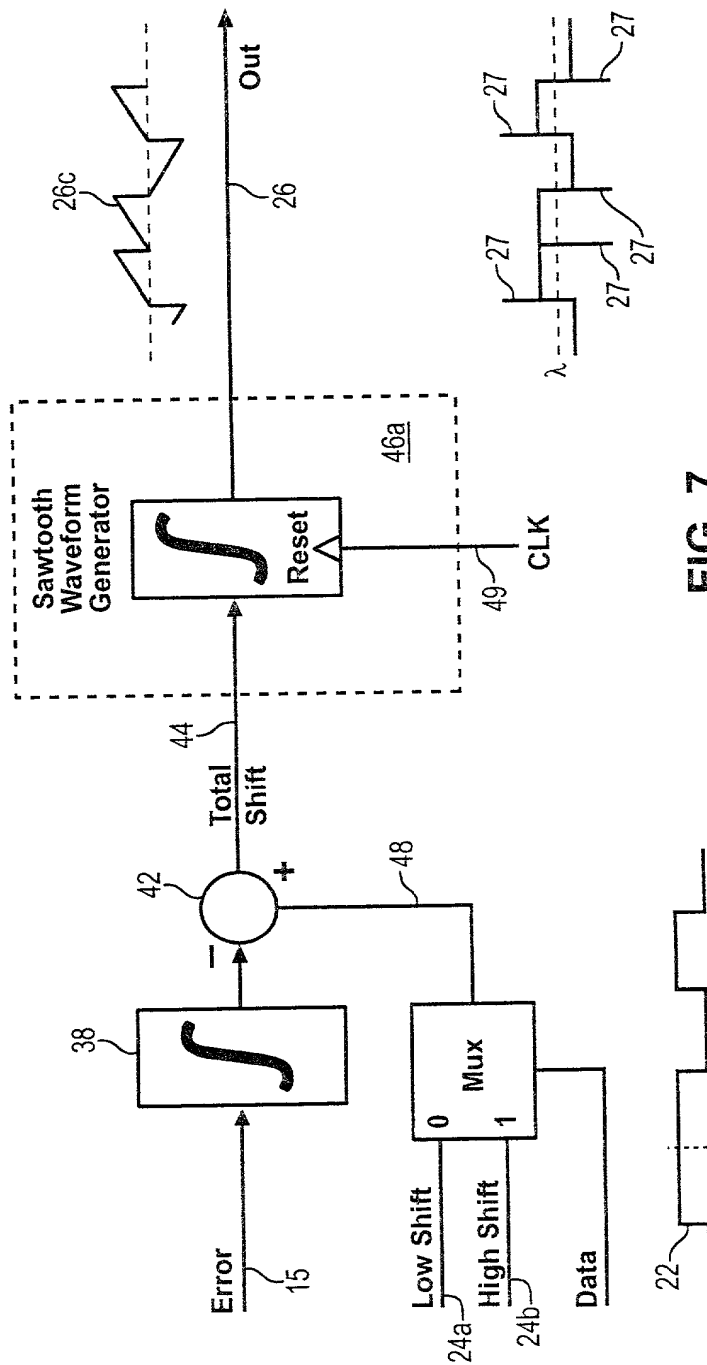
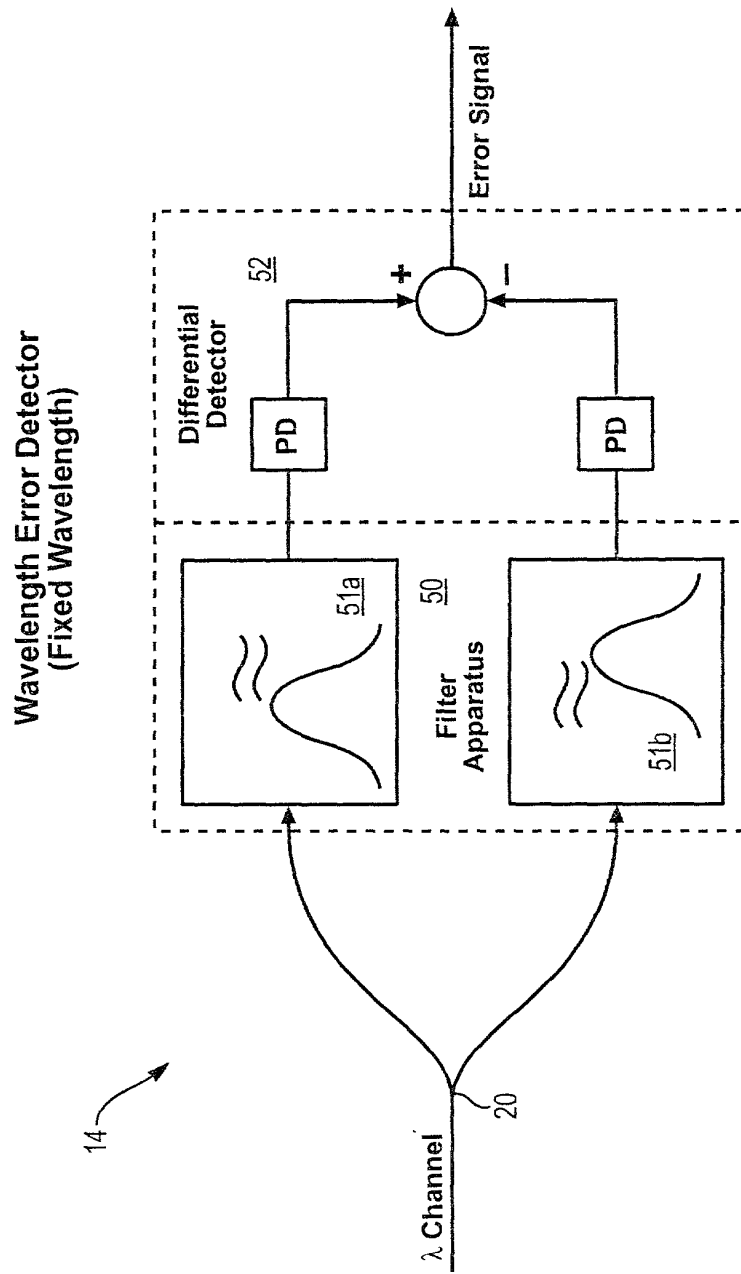


FIG. 7



**FIG. 8**



FIG. 9 is a block diagram of a Wavelength Error Detector (Tunable) 14. The detector 14 includes an input 20 for an input wavelength  $\lambda$  In. The input 20 is connected to a Modulation Device 16a and a Modulation Device 16b. A Modulation Synthesizer 12 is connected to the Modulation Device 16a and the Modulation Device 16b. The Modulation Synthesizer 12 provides a Shift  $24$  to the Modulation Device 16a and a Shift  $24$  to the Modulation Device 16b. The Modulation Device 16a outputs a signal  $\lambda \text{ REF} + \Delta$  to a Filter Apparatus 50. The Modulation Device 16b outputs a signal  $\lambda \text{ REF} - \Delta$  to the Filter Apparatus 50. The Filter Apparatus 50 is connected to a Differential Detector 52. The Differential Detector 52 includes two Photodiodes (PD) 56b and a summing junction. The output of the Differential Detector 52 is an Error signal 15.

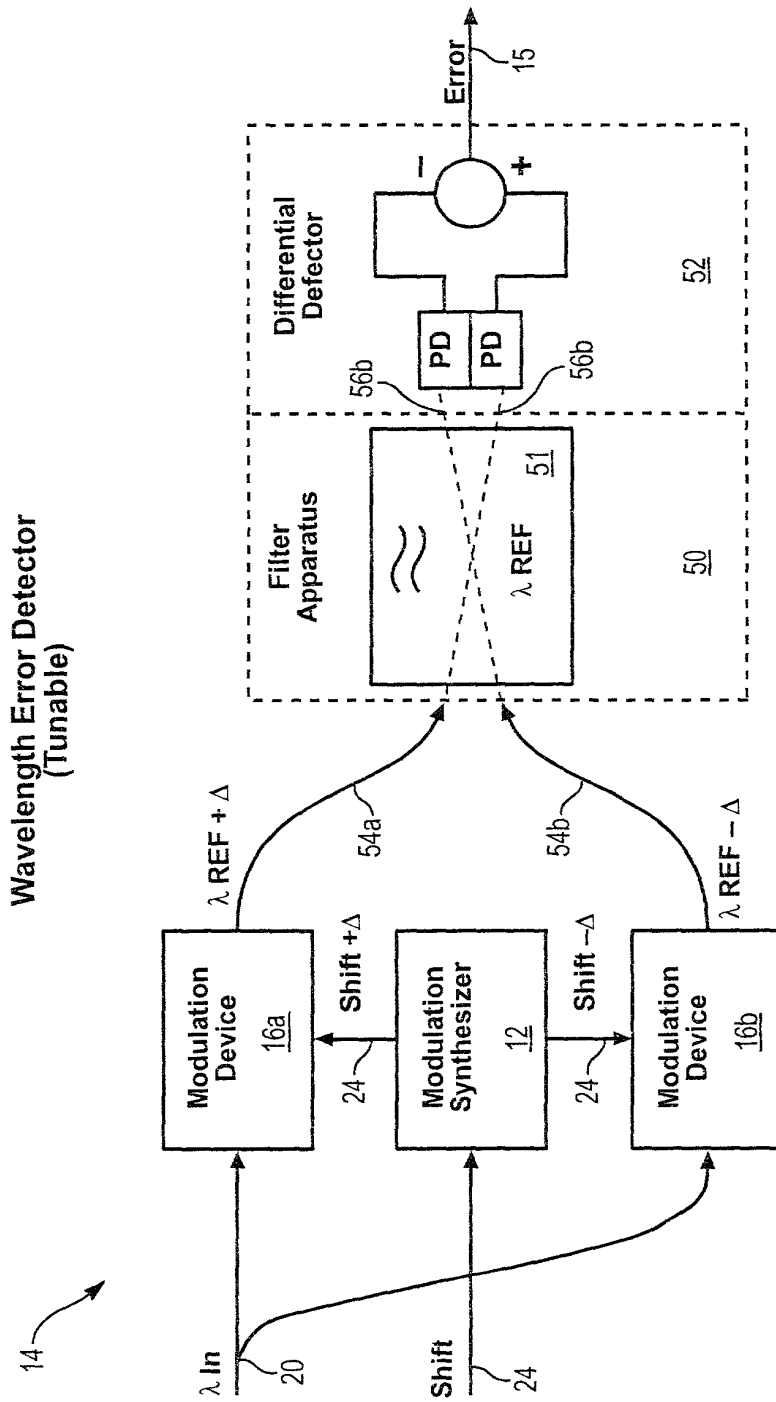


FIG. 9

14

# Wavelength Error Detector (Tunable)

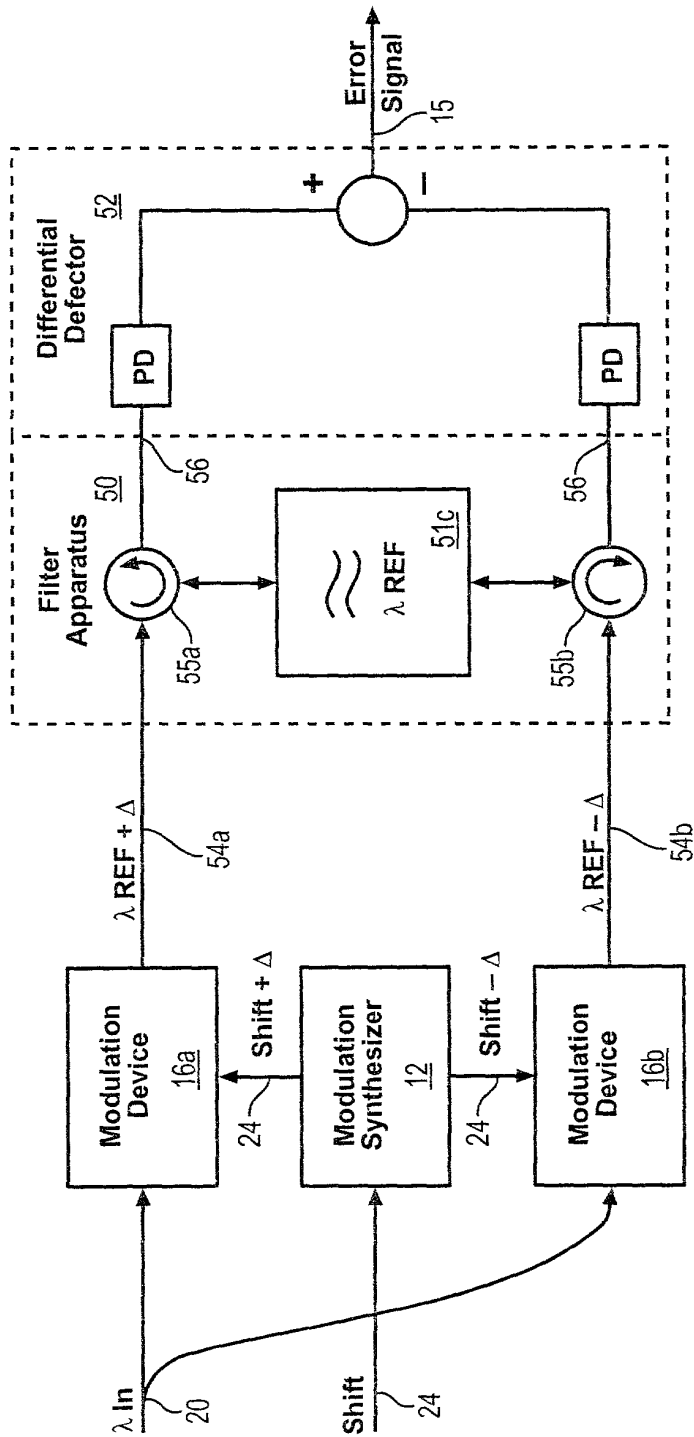


FIG. 10



70

# Tunable Wavelength Stabilized Transmitter

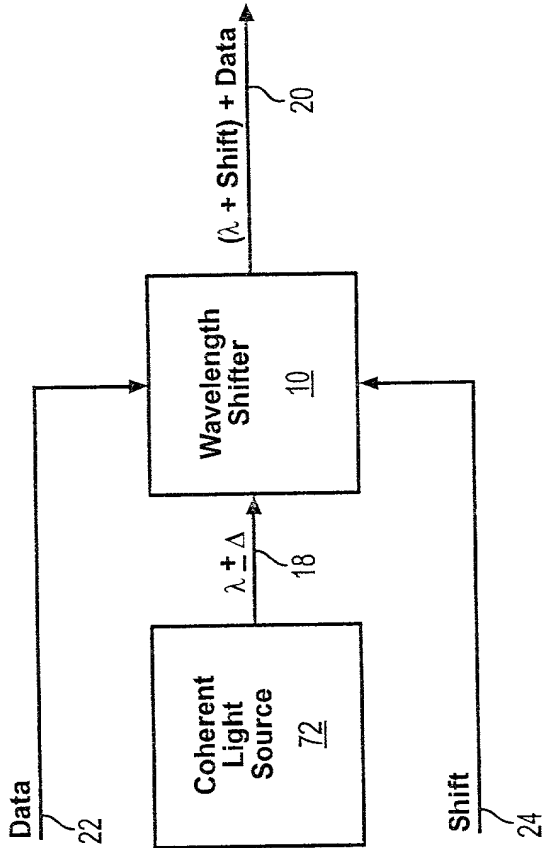


FIG. 12

74

# Recursive Wavelength Shifter

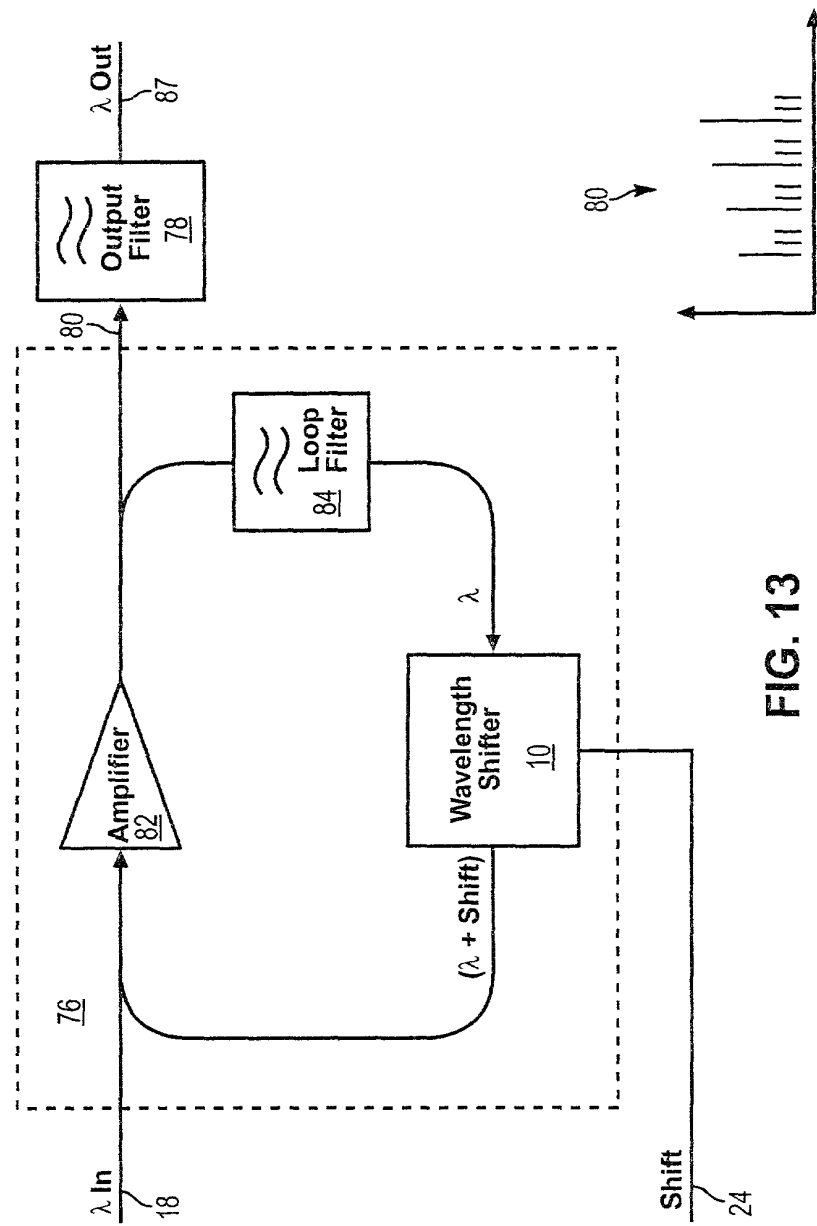


FIG. 13

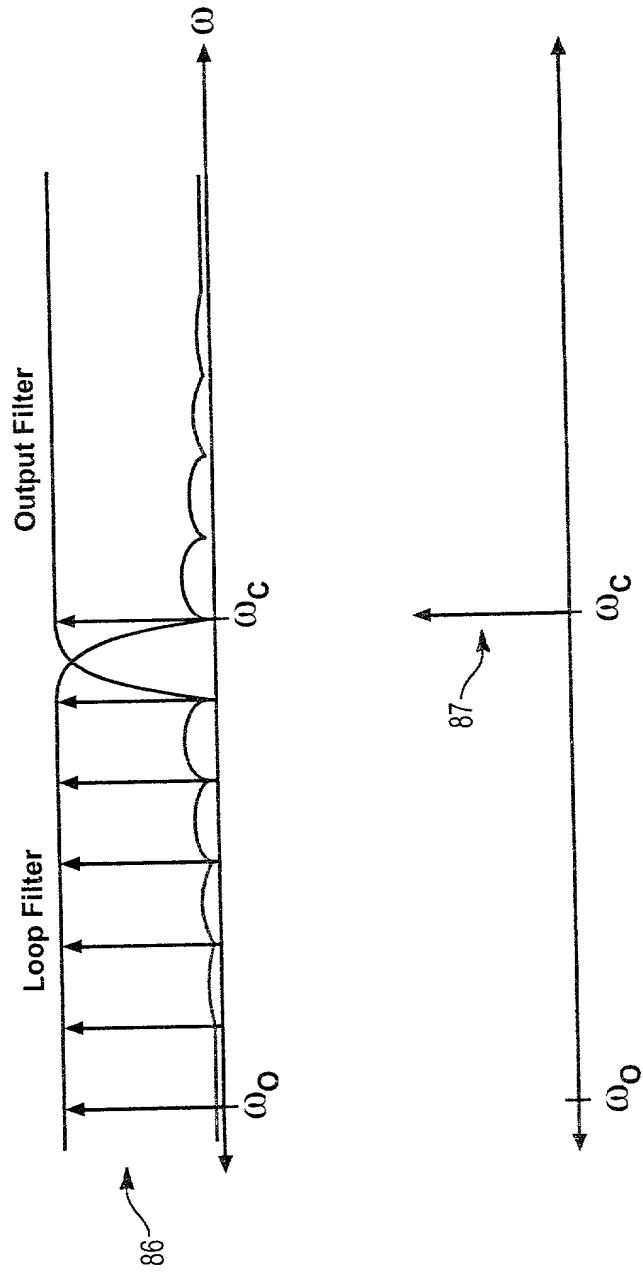


FIG. 14